

CIRCUIT DESCRIPTION

CD-95612-01
ISSUE 5B
· APPENDIX 3D
DWG ISSUE 18D

35

COMMON SYSTEMS
PRIMARY AND SECONDARY
TEST CIRCUIT
LOCAL TEST DESK NO. 14

CHANGES

D. Description of Changes

D.1 This circuit is rated A&M only along
with various other circuits in the
No. 14 LTD - which will be replaced by
the No. 16 LTD.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5225-LCB
WECO DEPT 5155-RRR-WEA

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COMMON SYSTEMS
PRIMARY AND SECONDARY
TEST CIRCUIT
LOCAL TEST DESK NO. 14

CHANGES

D. Description of Changes

D.1 This reissue on AR basis was to change the termination in the circuit of the paired ground lead run with the +48 volt talking battery. The change is to minimize noise pickup in the talking power supply for lines under test.

D.2 In FS 11 ground B lead is removed from its indicated ground symbol and is now connected to ground A through the REX key.

D.3 CADs 2 and 13 have been changed to conform to the change in item D.2.

F. Changes in Description of Operation

F.1 Under SECTION II, in 4.75 add the following.

(e) Connects together the A and B grounds from the A (-48 volt) and B (+48 volt) talking battery supplies to maintain a balanced path to minimize noise pickup.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5822-KES-RMA,JR

COMMON SYSTEMS
PRIMARY AND SECONDARY
TEST CIRCUIT
LOCAL TEST DESK NO. 14

CHANGES

D. Description of Changes

- D.1 This reissue was made to clarify the provision of options and notes for Unigauge and Dial-Tone-First features.
- D.2 FS 11 has been changed to show the +48 volt talking battery is from a fuse panel instead of from a specific 48-volt power plant. This positive supply is now designated TALK B and the negative talking battery supply is now designated TALK A. The associated grounds are likewise designated B and A.
- D.3 FS 2 has had corresponding changes made in it for the positive and negative talking batteries.
- D.4 CADs 2 and 3 have been changed to show the talking battery designations.
- D.5 Circuit Note 102 has been changed to more accurately cover the provision of features required for Unigauge testing. Previously it was necessary for the entire Unigauge capability to be supplied even when only the REX key was required for Unigauge testing via remote testing facilities.
- D.6 Option ZN is deleted entirely. It was previously incorrectly and unnecessarily used.
- D.7 In FS 10 wiring associated with the REX key and REX relay has been changed to effect conditions listed in change D.5. Note 111 has been changed for the same reason.
- D.8 To clarify Dial-Tone-First testing features, Notes 102 and 112 have been modified. Note 113 has been replaced entirely by a new Note 113. Note 104 has similarly been revised regarding options ZO, ZR, and ZQ.
- D.9 Note 104 has been changed to change rating of option ZF from Mfr Disc. to A&M Only. Second column in the Note is changed to show "ZF or ZT" instead of just "ZT".
- D.10 In CAD 2, the destination of lead from punching 28 has been corrected.

D.11 In FS 14, the name of the connecting circuit in a double line box has been corrected.

D.12 At the request of WECO the connecting information for leads B, C, and ST (E option) in FS 12 has been changed.

F. Changes in Description of Operation

F.1 Under SECTION II, change first sentence of 4.43 to read: "An initial deposit in a multislot coin station (such as 200-type) or any deposit in a single slot coin station (such as 1A or 1C-type) should cause the hopper trigger to close and apply ground to the coin relay."

F.2 Under SECTION II, change 4.51 to read: "In a single slot coin station (such as 1C-type) arranged for dial-tone-first and an initial deposit of over one nickel, a diode shunt around the totalizer prevents a single nickel readout while normal negative talking battery is applied to the ring lead."

F.3 Under SECTION II, change first sentence of 4.53 to read: "Single slot coin telephones (such as 1C-type) arranged for dial-tone-first have an SCR and diode shunt circuit in parallel with the totalizer contacts in the coin relay path."

F.4 Under SECTION II, change first sentence of 7.34 to read: "An initial deposit in a multislot coin station (such as 200-type) or any deposit in a single slot coin station (such as 1A- or 1C-type) should cause the hopper trigger to close and apply ground to the coin relay."

F.5 Under SECTION II, in 7.39, third sentence change (450 mA scale) to (480 mA scale).

F.6 Under SECTION II, change 7.42 to read: "In a single slot coin station (such as 1C-type) arranged for dial-tone-first and an initial deposit of over one nickel, a diode shunt around the totalizer prevents a single nickel readout while normal negative talking battery is applied to the ring lead."

F.7 Under SECTION II, change 7.44, first sentence, to read: "Single slot coin telephones (such as 1C-type) arranged for dial-tone-first have an SCR and diode shunt circuit in parallel with the totalizer contacts in the coin relay path."

F.8 Under SECTION II, in 7.46 change second sentence to read: "To test this, operate RCCI and REV keys. (T key must be normal.)"

F.9 Under SECTION II, change 4.60 to read: "When the Breakdown Circuit completes its cycle, the locking path for relay BD2 is opened and the relay releases. Lamp BT extinguished indicates that the test has been completed. All associated circuitry automatically restores to normal when the test cycle ends. The test can be repeated by momentarily reoperating key BT1 or BT2."

F.10 Under SECTION III, change drawing number in 4.01(g) to read SD-95772-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5822-KES-RMA,JR

COMMON SYSTEMS
PRIMARY AND SECONDARY
TEST CIRCUIT
LOCAL TEST DESK NO. 14

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

GENERAL

1.01 This circuit provides means for testing subscriber lines and cable conductors when connected through test trunks. Tests may be made to central offices at the same location as the test desk or at other locations.

PRINCIPAL FUNCTIONS

1.02 Two test circuits, primary and secondary, are provided. These circuits are complete in themselves. In addition, a third test circuit is derived from the other two when remote testing is used. Normally, the basic primary and secondary test circuits are connected to the primary and secondary cords, respectively. Operation of a key, designated X, transposes the connections between these test circuits and the test cords. The third test circuit, used for remote testing, is always associated with the primary test cord.

1.03 Tests may be made to central offices in the same building as the test desk (on premises) or to central offices at other locations (off premises). Testing to off-premises locations is done over either a dedicated dc test trunk facility, or over a voice-frequency facility which may be either dedicated or not. When using the dc test trunk (not using remote testing) the introduction of additional test trunk losses, in some cases, may require an adjustment of the testing conditions. This is done by operation of a key designated DO.

2. GENERAL DESCRIPTION

2.01 Two test circuits, primary and secondary, are provided. Each has specific test features. Normally, connection is provided to a primary and secondary

test cord, respectively, but the test circuits may be transposed by the operation of a key designated X. An exception is the receiver off-hook tone application feature of the secondary circuit which cannot be transferred to the primary cord. A third cord, SO, is provided to furnish tone for the identification of cable conductors.

2.02 The primary test cord tip and ring conductors may be switched from the primary test circuit to the Wheatstone Bridge Test Circuit when bridge measurements are required on a test connection. Operation of a key in the Wheatstone Bridge Test Circuit switches the primary cord. Operation of key X switches the Wheatstone bridge connection to the secondary cord.

2.03 Both primary and secondary tip, ring, and sleeve conductors may be switched from the primary and secondary test circuits to the MF keypulse circuit, when it is provided.

2.04 Tests may be made to central offices in the same building as the test desk (on-premises testing) or to central offices at other locations (off-premises and remote testing). When testing off-premises locations, the introduction of additional test trunk losses requires, in some cases, an adjustment in the test setup. A key, designated DO, provides for making the adjustment.

2.05 When remote testing is used, the keys of this circuit are transferred to the near-end remote testing circuit (RTC), with some exceptions. The near-end RTC, in turn, controls the far-end RTC in the distant office. The far-end RTC includes a relay equivalent of this circuit. Also included in the remote testing circuits is a telemetering arrangement that allows the test desk meter and supervisory lamps to read out the results of the tests done by the far-end RTC.

SECTION II - DETAILED DESCRIPTION

1. BASIC PRIMARY TEST CIRCUIT - REMOTE TESTING NOT USED (FS 1)

CONTROL OF PRIMARY TIP, RING, AND SLEEVE CONDUCTORS

1.01 Key REV (PRI) operated operates relay RV under control of EL VM. Relay RV operated:

- (a) Reverses the tip and ring conductors.
- (b) Provides ground for functions described in 3.08 to 3.17.
- (c) Provides a locking and transfer path covered in the circuit description of the electronic voltmeter test circuit.

1.02 Key SC operated disconnects the tip conductor from the test circuit and connects it to the ring conductor. Key IN operated:

- (a) Connects the sleeve conductor to low resistance negative 48-volt battery.
- (b) Lights lamp P.
- (c) Operates relay NP.

1.03 The use of IN key is described in detail in 3.39 to 3.41. Key 3WO (PRI) operated:

- (a) Opens the sleeve conductor.
- (b) Closes, in part, a resistance bridge path described in 4.21 through 4.24.

TALKING AND MONITORING CONNECTIONS

1.04 The talking connection is established by operating key T (PRI). Key T (PRI) operated:

- (a) Closes, in part, the path from the tip conductor to the Telephone Circuit (lead T1).
- (b) Closes, in part, the transformer path of the Telephone Circuit (leads T3 and R3).
- (c) Operates the cut-through relay in the Telephone Circuit (lead A).
- (d) Operates relay TK.

1.05 Relay TK operated:

- (a) Completes the tip conductor connection to the Telephone Circuit (lead T1).
- (b) Completes closure of the transformer path of the telephone circuit (leads T3 and R3).

(c) Transfers the ring conductor from the meter circuit to the Telephone Circuit (lead R1).

Note 1: The sequence adjustment of the T (PRI) key and the sequence operation of the T (PRI) key and relay TK are provided to minimize clicks in the Telephone Circuit.

Note 2: Capacitors PT and PR are provided to block direct current to the Telephone Circuit.

1.06 Talking battery is supplied to the tip and ring conductors by operating key RCCI. Key RCCI operated:

- (a) Transfers the ring conductor from the normal test connection with the negative terminal of the meter to talking battery through the 480-ma meter terminals in series with windings of relay R and transformers P and P1.
- (b) Closes, in part, a path for grounding the tip conductor through windings of transformers P and P1, and relay P. (This path is completed by operation of key T.)
- (c) Removes test battery from the meter.

1.07 The monitoring connection is established by operating the M (PRI) key. Key M (PRI) operated:

- (a) Transfers the tip and ring conductors to the monitoring leads of the Telephone Circuit (leads T4 and R4).
- (b) Operates the monitoring relay in the Telephone Circuit (lead M).

2. BASIC SECONDARY TEST CIRCUIT - REMOTE TESTING NOT USED (FS 2)

CONTROL OF SECONDARY TIP, RING, AND SLEEVE CONDUCTORS

2.01 Key REV (SEC) operated:

- (a) Reverses the tip and ring conductors.
- (b) Provides ground for functions described in 3.08 to 3.17.

2.02 Key G (SEC) connects ground to the tip conductor. Key 3WO (SEC) operated opens the sleeve conductor. Key PS PLS operated:

- (a) Opens the sleeve conductor.
- (b) Connects the tip through relay RL to battery and the ring through a resistor to battery. Use of the PS RLS key is described in 3.25 to 3.31.

2.03 Key IN (SEC) operated:

- (a) Connects the sleeve conductor to low-resistance, negative 48-volt battery.
- (b) Lights lamp S.
- (c) Operates relay NS. The use of key IN is described in detail in 3.39 to 3.43.

TALKING AND MONITORING CONNECTIONS

2.04 The talking connection is established by operating the T (SEC) key. Key T (SEC) operated:

- (a) Closes the transformer path of the Telephone Circuit (leads T3 and R3).
- (b) Operates the cut-through relay in the Telephone Circuit (lead A).
- (c) Connects the tip and ring conductors through capacitors ST and SR to the Telephone Circuit (leads T1 and R1). (The capacitors are provided to block direct current to the Telephone Circuit.)

Note: The sequence adjustment of key T (SEC) minimizes clicks in the Telephone Circuit.

2.05 Talking battery on the tip and ring conductors is removed by operating key RCOO. The monitoring connection is established by operating the M (SEC) key. Key M (SEC) operated:

- (a) Transfers the tip and ring conductors to the monitoring leads of the Telephone Circuit (leads T4 and R4).
- (b) Operates the monitoring relay in the Telephone Circuit (lead M).

3. ESTABLISHING CONNECTIONS TO TEST TRUNKS - REMOTE TESTING NOT USED

TEST TRUNKS TO SWITCHBOARD

3.01 The test cord, associated with either the primary or secondary test circuit, is connected to a switchboard test trunk, and the subscriber number is passed to the operator over a call circuit or talking trunk.

3.02 Connection of the test trunk to the subscriber line by the switchboard operator operates relay PS (primary circuit) or relays SS and SS1 (secondary circuit).

3.03 Relay PS or SS1 operated provides battery through 1000 ohms to light lamp P or S, respectively.

3.04 With keys T (PRI) and RCCI (PRI), or key T (SEC) operated, talking battery is furnished to the line, and on-off hook supervision is provided by relay P and lamp P or by relay S and lamp S. The tip and ring conductors bridged, or the ring conductor grounded, operates P or S. Relay P operated shunts and extinguishes the P lamp. Relay S operated operates relay SR1. Relay SR1 operated shunts and extinguishes lamp S.

3.05 Connections to subscriber lines through a plugging-up panel, sender make busy frame, or outgoing trunk testboard are established in a similar manner.

TEST TRUNKS TO PANEL OR CROSSBAR OFFICES VIA B SWITCHBOARDS

3.06 Operation of keys T (PRI) and RCCI (PRI), or key T (SEC) prepares the test circuit for talking to the B operator over the test trunk. In crossbar No. 1 offices, operation of key REV reverses the tip and ring conductors to signal the terminating equipment that the called number is in the extra number series.

3.07 Connection to the test trunk completes the talking connection to the B operator for ordering up the subscriber line. The B operator completes the connection. During selection, continuous low tone is heard. Interrupted tone indicates overflow. Connection to the subscriber line disconnects the steady tone. Talking battery and on-off hook supervision are furnished to the line.

Note 1: If the test trunk is arranged for no-test operation, key M (PRI or SEC), operated after the number is passed, permits monitoring before testing.

Note 2: In crossbar offices, with keys T (PRI or SEC) or M (PRI or SEC) and 3W0 (PRI or SEC) operated, connection through a no-test test trunk is indicated by steady high tone.

TEST TRUNKS USING DIAL PULSE TERMINATING EQUIPMENT (SEE FS 3)

3.08 Connection is established directly through the terminating equipment by use of the position dial. In crossbar No. 1 offices, key REV (PRI or SEC) provides a signal to the terminating equipment that the called number is in the extra number series. Key REV (PRI) operates RV which provides a 1000-ohm ground to the ring conductor under control of relay DB. Key REV (SEC) provides the 1000-ohm ground under control of relay DD.

3.09 Key DIAL (PRI or SEC) operated lights lamp P or S and operates relay DB or DD. Relay DB or DD operated:

- (a) Connects low-resistance battery to the sleeve conductor.
- (b) Closes, in part, a path for the operation of relay DA or DC.
- (c) Closes, in part, the ground path to resistor P.
- (d) Operates relay NP or NS.

3.10 Relay NP or NS operated, locks to battery from resistor J or C and operates relay DA or DC. Relay DA or DC operated:

- (a) Locks under control of relay NP or NS.
- (b) Closes, in part, a path to extinguish lamp P or S.
- (c) Transfers the tip and ring conductors to control of relay D.
- (d) Operates relay D.

3.11 Relay D operated:

- (a) Disconnects the position dial from the Telephone Circuit and bridges it, in series with relay DE, across the tip and ring conductors.
- (b) Closes, in part, a path from dial off-normal ground, to extinguish lamp P or S during pulsing.

3.12 When the test cord is connected to a test trunk, low-resistance battery on the sleeve and the bridge of relay DE causes the terminating equipment to function. A reversal in the terminating equipment operates relay DE. (In step-by-step offices the polarity is initially in the operate direction.) Relay DE operated extinguishes lamp P or S as a signal that the terminating equipment is prepared to receive dial pulses.

3.13 Dialing the called number causes the terminating equipment to establish the connection to the subscriber line. In other than step-by-step offices, current in relay DE again reverses; this causes relay DE to release and light lamp P or S. In a step-by-step office, this condition indicates a connection to a busy line.

3.14 Key M (PRI or SEC), operated before the release of key DIAL (PRI or SEC), prepares the test circuit for monitoring. Key DIAL (PRI or SEC), released, releases relay DB or DD. Relay DB or DD released:

- (a) Opens the operating path for relay DA or DC.
- (b) Opens the ground path to resistor P, if key REV (PRI or SEC) has been operated.
- (c) Releases relay NP or NS.

3.15 Relay NP or NS released connects high-resistance battery to the sleeve conductor and releases DA or DC, restoring the circuit to the test condition. Relay PS or SS operates.

3.16 Connection of high-resistance battery to the sleeve conductor and removal of the DE relay bridge signals the test trunk to cut through for testing.

3.17 With key T (PRI) and RCCI (PRI), or key T (SEC) operated, talking battery and supervision are furnished to the line. In other than step-by-step offices, steady low tone furnished by the terminating equipment indicates that the test connection has not been completed. Interrupted low tone indicates that an overflow condition has been encountered.

TEST TRUNKS USING MF PULSING TERMINATING EQUIPMENT

3.18 If connections to subscriber lines are to be established through multi-frequency terminating equipment, the MF keyset is provided. The MF keyset may be connected to either the primary or secondary test cord to furnish multi-frequency pulses to the terminating equipment for controlling selection of the called number.

3.19 In No. 1 crossbar offices, connection may be made to a subscriber line in either the regular or extra-number series. Connection to a No. 1 crossbar subscriber line in the extra number series requires operation of key REV (PRI or SEC) secondary test circuit. For other types of calls the REV (PRI or SEC) key must be normal. The REV key (PRI or SEC) operated, provides ground over lead X or X1 to operate a relay in the MF keyset circuit; this indicates to the terminating equipment that the call is to a line in the extra number series.

3.20 With key REV (PRI or SEC) normal or operated, as required, the plug of the primary or secondary test cord is inserted in an idle test trunk and the proper key KP in the MF Keyset Circuit is operated.

3.21 Key KP operates a relay in the MF Keyset Circuit which transfers the tip and ring of the test cord to the MF Keyset Circuit and transfers the sleeve of the test cord to low-resistance battery, to operate a marginal relay in the test trunk terminating equipment.

3.22 The MF Keyset Circuit functions, in conjunction with the test trunk terminating equipment in a crossbar office, to summon and attach a sender or register and MF receiver. Lamp S of the MF keyset is lighted when the terminating equipment is prepared to receive numerical pulses.

3.23 By the operation of numerical keys corresponding to the number of the called subscriber line (including an office digit when required), numerical pulses are

transmitted to the MF receiver which operates relays in the sender or register; this controls the selection of the called number.

3.24 After numerical pulsing is completed, key KP is released; the MF Keyset Circuit is disconnected from the T, R, and S leads of the primary or secondary test circuit; and a connection is established to the called subscriber line.

PERMANENT SIGNAL AND CONNECTOR RELEASE (STEP-BY-STEP OFFICE)

3.25 With connection established from the secondary test circuit to a line on permanent signal, a release condition is applied to the first selector or connector by the operation of key PS RLS (see FS2). Key PS RLS operated:

- (a) Connects battery through the winding of RL to the tip conductor.
- (b) Connects battery through resistor RL to the ring conductor.
- (c) Opens the sleeve conductor.
- (d) Removes enabling ground to the Telephone Circuit (lead A).

3.26 The terminating circuits return interrupted ground over the tip conductor. RL follows the interruptions and flashes lamp S as an indication that the release condition is being applied.

3.27 Failure of the first selector or connector to release provides steady ground on the tip to operate RL and light lamp S. Release of the first selector or connector opens the tip conductor. RL releases and lamp S is extinguished. Key PS RLS released restores the circuit to the test condition.

3.28 With a test connection established, using the secondary test circuit, key DIAL (SEC), reoperated, reestablishes the dialing circuit and the test connector may be advanced to another line on the same level by dialing the proper digit. Key DIAL (SEC) released restores the circuit to the test condition.

3.29 With keys DIAL (PRI or SEC) and CONN RLS operated, the bridge is disconnected from the tip and ring conductors, and the battery is connected to the ring conductor to release the test connector. The test distributor is held by low-resistance battery over the sleeve conductor.

3.30 After allowing sufficient time for the test connector to restore to normal, key RLS CONN released restores the circuit to the dialing condition. Dialing

the proper digits will pulse the test connector to another line on a different level.

3.31 Voltage variation on some test connections may prevent the release of the test connection. Lamp P or S lighted, when key CONN RLS is released, indicates that the test connector has not released. Ten-party terminal per line connectors cannot be advanced to another line on the same level.

TEST TRUNKS REACHED THROUGH A TEST TRUNK SELECTOR

3.32 A test trunk selector (see FS3), located at a point distant from the test desk, provides for switching a common test desk trunk to one of a group of test trunks to a central office.

3.33 Key DIAL (PRI or SEC) operated lights lamp P or S and operates relay DB or DD. Relay DB or DD operated:

- (a) Connects low-resistance battery to the sleeve conductor.
- (b) Closes, in part, a path for the operation of relay DA or DC.
- (c) Operates relay NP or NS.

3.34 Relay NP or NS operated locks to battery from resistor C or J and operates relay DA or DC. Relay DA or DC operated:

- (a) Locks under control of relay NP or NS.
- (b) Closes, in part, a path to extinguish lamp P or S.
- (c) Transfers the tip and ring conductors to control of relay D.
- (d) Operates relay D.

3.35 Relay D operated:

- (a) Disconnects the position dial from the Telephone Circuit and bridges it, in series with relay DE, across the tip and ring conductors.
- (b) Closes, in part, a path from dial off-normal ground to extinguish lamp P or S during pulsing.

3.36 When the test cord is connected to a test trunk selector, low-resistance battery on the sleeve and on the bridge of relay DE causes the test trunk selector to function. Battery and ground from the test trunk selector operates relay DE which extinguishes lamp P or S as a signal that the test trunk selector is prepared to receive dial pulses. Dialing the proper digit

causes the test selector to seize an idle trunk to the central office. The subscriber line is selected as described in 3.01 to 3.24.

Note: An all-trunks-busy condition at the test trunk selector is indicated by a reversal. Relay DE is released and lamp P or S is lighted.

TEST TRUNKS - INCOMING CALLS

3.37 An incoming call is signaled by a flashing lamp associated with the test trunk. Connection of the test cord to the test trunk operates relay PS (PRI) or SS and SS1 (SEC). With keys T and RCCI (PRI) or key T (SEC) operated, talking battery and supervision are furnished to the line. On calls from district or office multiple or from selector levels, the terminating circuits are advanced to complete the connection.

TEST TRUNKS (IN AND OUT TYPE) TO MDF, JACK PANEL, OR TOLL TESTBOARD

3.38 Connection to the line at the MDF, jack panel, or toll testboard and connection of the test cord at the test desk establishes the test connection.

3.39 High-resistance battery connected to the sleeve conductor causes the test trunk to connect the "out" side of the line to the tip and ring conductors. Relay PS or SS (and SS1) is operated and lamp P or S is lighted. Key IN (PRI or SEC) operated:

- (a) Connects low-resistance battery to the sleeve conductor.
- (b) Lights lamp P or S.
- (c) Operates relay NP or NS.

3.40 Relay NP or NS operated locks and opens the high-resistance battery path. Low-resistance battery connected to the sleeve conductor causes the test trunk to connect the "in" side of the line to the tip and ring conductors.

3.41 Key IN (PRI or SEC) released, restores the test trunk to the "test out" condition and shunts the winding of relay NP or NS. Relays NP and NS are slow release to permit the release of the test trunk marginal relay before high-resistance battery is connected to the sleeve conductor.

3.42 Key 3WO (PRI or SEC) operated opens the sleeve conductor, causing the test trunk to bridge the "in" and "out" side of the line to the tip and ring conductors. Key 3WO (PRI or SEC) released restores the test trunk to the test-out condition.

4. PRIMARY TEST CIRCUIT - REMOTE TESTING NOT USED

4.01 With connection to a line established, as discussed in 3.01 to 3.43, testing features are provided as described in 4.02 to 4.04.

TEST BATTERY, METER, AND SCALE CHANGE KEYS
(FS 9, 15, 16, 17)

4.02 Test battery for the primary test circuit is provided through scale change keys and the meter as indicated in Table A.

TABLE A

Keys Operated	Full Scale Deflection	Battery Voltage	Meter Resistance
		volts	ohms
None	120v	+100	100,000
60V	60v	+50	50,000
24V	24v	+20	20,000
24MA	24 ma	+20	1,000
*	1.2 ma	*	800
RCCI	480 ma	-48	4

*The functions of this meter scale are described in 4.14 to 4.20, 5.29 to 5.39. Central office battery is used for the -48 volt supply.

4.03 In each position not equipped with a Wheatstone bridge, a dry battery provides 50- and 100-volt supply. The negative terminal of this battery is grounded under control of key MET VM. A dry battery, common to eight positions, provides 20-volt supply. The negative terminal of the 20-volt battery is permanently grounded.

4.04 In a position equipped with a Wheatstone bridge, a dry battery provides 20-, 50-, and 100-volt supply. The negative terminal of this battery is grounded under control of key MET VM. Test battery voltages are measured as indicated on the drawing.

TESTS USING THE METER CIRCUIT (FS 9)

A. Tests for Bridges and Grounded Conductors

4.05 With the scale change keys (Table A) operated as required and all test keys normal, test battery through the meter is connected to the ring conductor. A grounded ring conductor is indicated by a steady deflection of the meter. With key REV (PRI) operated, the test is applied to the tip conductor.

4.06 With key G (PRI) operated, ground is connected to the tip conductor and

the test is applied to the ring conductor. A bridge across the tip and ring conductors is indicated by a steady deflection of the meter.

4.07 With key SC operated, the tip and ring conductors are short-circuited and the test is applied to both. With key MET VM operated, the negative test battery terminal is transferred from ground to the tip conductor and the test is applied to the ring conductor. A bridge across the tip and ring conductors is indicated by a steady deflection of the meter.

4.08 With key FEMF operated, the negative terminal of the meter is connected to the ring conductor and the positive terminal is grounded. Negative foreign potential on the ring conductor is indicated by a steady deflection of the meter. Positive foreign potential is indicated by a reverse deflection.

4.09 Key VM REV, operated in conjunction with key FEMF, reverses the polarity of the meter. Key REV (PRI), operated in conjunction with keys FEMF and VM REV, applies the test to the tip conductor.

B. Tests for Line Capacity

4.10 Capacity on the line is indicated by a momentary deflection of the meter when connected to the line, and when keys G (PRI) and REV (PRI) are operated.

C. External Circuit Resistance

4.11 In testing grounded or bridges conductors, the external circuit resistance may be determined by:

$$\text{EXT CKT RES} = \frac{(V-M)R}{M}$$

where V = test battery voltage, M = voltage reading of the meter, and R = total resistance of the meter test circuit. The meter test circuit resistance closest to the external resistance gives the most accurate results (Table A).

4.12 Using the 480-ma scale (Table A), the external resistance may be determined by noting the current flow, withdrawing the plug of the test cord from the test jack, and inserting it in jack SC. With keys G (PRI) and RHE operated, and with the 1000-ohm and/or 2000-ohm key operated as required, the rheostat is adjusted to give the same current flow as noted in the test. The external resistance may be read from the rheostat dials and keys.

D. Line Identification in Crossbar Offices

4.13 With a test connection established and key 3WO (PRI) operated, line identification is indicated on the meter as shown in Table B.

TABLE B

Test Indication	Type of Line	
	Crossbar No. 1	Crossbar No. 5
-48V on ring	Ring party, individual line, or last line of hunting group	Ring party or individual line
-24V on ring	-	Ring party or individual line (Unigauge)
-48V on tip	Tip party	Tip party
-24V on tip	-	Tip party (Unigauge)
Direct ground on ring	PBX line in terminal hunting group	PBX hunting line including last line of hunting group
1000 ohm ground on ring	-	PBX hunting line including last line of hunting group (Unigauge)

E. Wheatstone Bridge Connection

4.14 The meter may be switched to the Wheatstone Bridge Test Circuit for voltmeter bridge tests when App Fig. B is provided. Operation of a key in Wheatstone Bridge Test Circuit operates relay VB. Relay VB operated:

- Disconnects the ring conductor from the meter.
- Transfers test battery (lead 4).
- Opens the 480-ma meter connection.
- Connects the 24-ma (1000-ohm) meter terminal (lead 2).
- Transfers the 1.2-ma (800-ohm) meter terminal (lead 1).
- Transfers the negative meter terminal (lead 3).

4.15 Use of the test desk meter under this condition is covered in the circuit description for the Wheatstone Bridge Test Circuit.

METER TESTS USING THE ELECTRONIC VOLTMETER TEST CIRCUIT

4.16 Key EL VM operated:

- Operates relay ELV.

(b) Connects the negative meter terminal to the output of the Electronic Voltmeter Test Circuit.

(c) Disconnects the test battery supply from the meter.

4.17 Relay ELV operated:

(a) Connects ground to lead 12 of the Electronic Voltmeter Test Circuit to start functions in that circuit.

(b) Connects the tip and ring of the test cord circuit to the ELVM circuit.

(c) Connects the 1.2-mA terminal of the meter to the Electronic Voltmeter Test Circuit.

4.18 The Electronic Voltmeter Test Circuit, in conjunction with primary test circuit keys, provides for the investigation of high-resistance conditions on the line being tested. Detailed operation is covered in the circuit description for the Electronic Voltmeter Test Circuit.

METER TEST FOR AC VOLTAGES (FS 9)

4.19 Key AC operated:

(a) Transfers the ring conductor from the meter to ground through resistors AC1 to AC8, the ac section of rectifier AC and capacitor AC.

(b) Connects the dc section of rectifier AC to the 1.2-mA (800-ohm) meter terminal.

(c) Disconnects the test battery supply from the meter.

4.20 In conjunction with keys REV (PRI) 24V and 60V, the presence of ac potentials on the line under test may be detected and measured on the meter. The accuracy of ac measurements is within the rated accuracy of the meter at midscale only. The measurements may vary ± 5 percent of full scale for readings above midscale and ± 2 percent of full scale for readings below midscale.

TESTING SUBSCRIBER LINE RELAYS (OTHER THAN CROSSBAR OFFICES) (FS 1, 10)

4.21 With a noncoin or dial tone first coin subset in the on-hook condition and keys T (PRI) and 3WO (PRI) operated, the test circuit is connected for an operating test of the line relay. Key T (PRI) operated:

(a) Closes, in part, the tip conductor connection to the Telephone Circuit (lead T1).

(b) Closes, in part, the transformer path of the Telephone Circuit (leads T3 and R3).

(c) Connects ground to lead A to enable the Telephone Circuit.

(d) Operates relay TK.

4.22 Relay TK operated:

(a) Completes the tip conductor connection to the Telephone Circuit (lead T1).

(b) Completes the transformer path of the Telephone Circuit (leads T3 and R3).

(c) Transfers the ring conductor from the test circuit to the Telephone Circuit (lead R1).

4.23 Key 3WO (PRI) operated:

(a) Opens the sleeve conductor to release the line circuit cutoff relay.

(b) Connects a bridge across the tip and ring conductors to operate the line relay.

Note: The bridge consists of inductor BR and resistors LT, LT1 and LR, LR1, which are controlled in steps of 100 ohms by the operation of keys 100, 200, 200, 400, and 800 to provide a worst-circuit condition to the line relay. The inductor provides an impedance path in the bridge to minimize attenuation of dial tone.

4.24 Operation of the line relay is indicated by an operator answering or by dial tone. The operation for a coin prepay subset is the same as for a noncoin subset, except that key LRP is operated in addition to keys T (PRI) and 3WO (PRI). Key LRP operated connects ground through resistor EP and inductor L to the midpoint of the resistance bridge. The worst-circuit condition (including the effect of adverse earth potential) is applied to a line relay serving a coin prepay subscriber line.

DIAL ON SUBSCRIBER LINE (OTHER THAN CROSSBAR OFFICES) (FS 10)

4.25 With keys T (PRI), 3WO (PRI), and DSL (and LRP if required) operated, the position dial is connected to the test circuit to simulate dialing of a subscriber on the line. Keys T (PRI), 3WO (PRI), and LRP (if required) perform the same functions described in 4.21 to 4.25. Key DSL operated:

(a) Transfers the tip and ring conductors from the Telephone Circuit talking path (leads T1 and R1) to the line resistance bridge under control of DL.

(b) Shunts inductor BR to remove this impedance from the pulsing path.

(c) Short circuits leads T1 and R1 to the Telephone Circuit to provide a holding path for talking trunks.

(d) Operates relay DL.

4.26 Relay DL operated:

(a) Provides an additional short circuit to leads T1 and R1 of the Telephone Circuit.

(b) Splits leads T and R from leads T1 and R1.

(c) Connects the position dial (leads T and R) in the midpoint of the resistance bridge.

4.27 Operation of the position dial simulates the condition imposed on the central office equipment by the subscriber dial.

TEST OF COIN TRUNK CIRCUIT POTENTIAL (STEP-BY-STEP OFFICE) (FS 1, 10)

4.28 With connection established to a prepayment coin subset in the on-hook condition, keys T (PRI), 3WO (PRI), LRP, and DSL operated, prepare the circuit for dialing as described in 4.25 to 4.27. A coin trunk circuit is attached to the subscriber line by the central office equipment.

4.29 Dialing a line number selected to provide the required charge or no-charge condition to the coin trunk circuit, causes the central office equipment to complete the connection from the test circuit to the called line. Key DSL released, transfers the test circuit from the dialing to the talking condition. After off-hook and on-hook supervision has been provided at the called line, the coin potential of the coin trunk circuit may be tested.

4.30 Key CTT provides a path to maintain ground on the tip conductor when key T is released. Key T (PRI) released transfers the ring conductor to the meter. Under this condition, the coin trunk circuit returns coin potential over the ring conductor. To measure negative coin potential, the FEMF key is operated. To measure positive coin potential, the FEMF and VM REV keys are operated. Key CTT, released, removes ground from the tip conductor to signal coin disposal to the coin trunk circuit, which releases.

TRANSMISSION TEST (FS 11)

4.31 With keys TMT and RCCI operated, the circuit is arranged to make a talking test through a transmission loss pad to a subscriber line. Key RCCI operated:

(a) Transfers the ring conductor from the test circuit to talking battery in series with windings of relay P and transformers P and P1 and the 480-mA terminals of the meter.

(b) Closes, in part, a path for ground to the tip conductor through windings of relay P and transformers P and P1.

(c) Disconnects the test battery supply from the meter.

4.32 Key TMT operated:

(a) Short-circuits resistor MR.

(b) Closes the transformer path (terminals 1 and 6 of the transformer P).

(c) Completes the ground path to the tip conductor.

(d) Closes a talking path, through the transmission loss pad, from transformer P (terminals 2 and 5) to the Telephone Circuit (leads T2 and R2).

RELAY-TYPE SUBSETS (4-PARTY LINES) (FS 8)

4.33 Key SSRT operated:

(a) Connects the primary winding of transformer RT to ringing supply.

(b) Transfers the tip and ring conductors to the secondary winding of transformer RT in series with resistor RT.

(c) Connects the meter through inductor RT to the ring conductor.

4.34 Induced ringing, connected to the line, operates the subset relays. Operation of the relays connects the ringers to ground. With key 24MA operated (Table A), the deflection of the meter affords a comparative indication of the number of subsets connected to the ring side of the line. Key REV (PRI), operated in addition to the above, applies the test to the tip side of the line.

TUBE-TYPE SUBSETS (FS 6)

4.35 Key -STA or +STA, operated, operates relay STA. Relay STA operated:

(a) Transfers the 100,000-ohm (120-volt) meter terminal and the ring conductor to control of key -STA or +STA.

(b) Connects an 8000-ohm shunt (resistor SH) across the 100,000-ohm meter circuit.

(c) Opens the test battery supply.

4.36 Key -STA or +STA operated connects -116 or +116 volts, respectively through the shunted 100,000-ohm (120-volt) meter circuit to the ring conductor, causing the subset tubes to conduct and provide paths for the associated ringers. The meter deflection, in conjunction with known line conditions, provides an indication of the connection to subsets on the ring side of the line. Key REF (PRI), operated in addition to the above, applies the test to the tip conductor.

COIN STATION TESTS (FS 5)

A. Coin Relay

4.37 With the hopper trigger tripped in a coin subset, current flow tests of the coin collector relay may be made.

4.38 Key CC or CR operated, disconnects operating ground for the cut-through relay of the Telephone Circuit (lead A) and operates relay CN. Relay CN operated opens the 1.2-mA (800-ohm) meter connection and transfers the tip and ring conductors to control of keys CC and CR.

4.39 Key CC operated (when option Z0 is furnished), connects coin collect potential through the 480-mA meter circuit to the tip and ring conductors. Key CR operated connects coin return potential through the 480-mA meter circuit to the tip and ring conductors. Key RHE operated, provides for adjusting the current by means of the rheostat.

4.40 When option ZP and ZQ, or ZR are used, the operation of the CC or CR key connects coin potential to the tip through the 480-mA meter circuit. The ring is grounded through a resistor (ZQ) or a resistor and diode (ZR) with operation of the G key. Key RHE operated provides for adjusting the current by means of the rheostat.

4.41 The Z option provides positive coin collect and negative coin return. The Y option provides negative coin collect and positive coin return.

4.42 Slow-release relay CN provides time for the line to discharge through resistor CN and capacitor CN before the tip and ring conductors are restored to the normal test circuitry after the CR or CC key is released.

B. Coin Relay Ground Closure (Option ZP)

4.43 An initial deposit in a 200-type coin station or any deposit in a 1A-type coin station should cause the hopper trigger to close and apply ground to the coin relay. The presence of that ground can be verified by voltmeter tests on the tip lead as described in 4.05.

C. Chute Magnet (Option ZP)

4.44 In 200-type coin stations arranged for dial tone first service and an initial deposit of more than a nickel, a single nickel deposit should be trapped in the coin chute. A diode in parallel with the chute magnet is poled so normal negative talking battery on the ring lead is shunted around the magnet winding.

4.45 After the single nickel deposit no ground should be detected on the tip lead as described in 4.43. Operation of T(PRI) and RCCI keys should not release the nickel. Subsequent operation of the REV key to reverse the current in the loop should allow the magnet to operate and drop the nickel.

D. Ground Removal (Option ZP)

4.46 Coin telephones arranged for dial tone first may have a ground removal feature. A relay in the ring lead of the set operates on loop current of either polarity to open the ground path for the coin relay.

4.47 To test this feature, have the station personnel deposit a dime or two nickels, but only after waiting a few seconds after the request.

4.48 During that few seconds waiting time the tester operates the G key and holds the CR key operated. CR key operated operates relay CN. Relay CN operated disconnects the line from the talking battery and ground and from the Telephone Circuit. It transfers the tip lead to negative coin return potential through the CR key and the meter as described in 4.38 to 4.40, and transfers the ring lead to 1800-ohm ground through the operated G key. The meter will indicate some steady value of current over 20 mA. This current is loop current through the coin set back to the resistance ground. The value is high enough that the ground removal relay should operate.

4.49 When the coins are deposited, the hopper trigger closes to apply ground to the coin relay. If the ground removal relay has operated, the coin relay path will be open and the meter reading will remain steady. If the ground removal relay did not open the ground path, the meter reading will increase by at least 25 mA. Usually the coins will then be returned and the meter reading will return to the original value. In some long loop cases, the coins may be held and the meter reading will remain at the new higher value.

4.50 After the deposit and if no change in meter reading is noted, the closed hopper trigger can be verified by testing the tip lead for ground as in 4.43.

E. Totalizer Shunt Diode (Option ZP)

4.51 In a 1A type coin station arranged for dial tone first and an initial deposit of over one nickel, a diode shunt around the totalizer prevents a single nickel readout while normal negative talking battery is applied to the ring lead.

4.52 While T and RCCI keys are operated, a single nickel deposit should be made. No readout should be heard. Then operate REV key. This reverses the direction of loop current so the diode should not conduct. A nickel readout should now be heard.

F. SCR and Diode Shunts in Coin Relay Path

4.53 The 1A-type coin telephones arranged for dial tone first have an SCR (diode shunt circuit) in parallel with the totalizer contacts in the coin relay path. This circuit permits a single nickel deposit to be collected or returned even though the contacts are open.

4.54 After a single nickel deposit, the totalizer contacts should be open, but a ground should be detected on the tip lead when positive potential is used, and there is only little or no current in the ring lead. For positive potential on the tip, either of two diodes across the contacts should conduct.

4.55 With negative potential under about 60 volts on the tip, the path should appear open. To test this, operate T, RCCI, and REV keys. The meter should indicate only normal leakage current. This tests for ground with the -48 volt talking battery.

4.56 Next operate the CR key. The high negative potential should break down a zener diode and trigger the SCR on. The meter should kick upward while the coin is being returned.

LINE INSULATION BREAKDOWN (FS 7)

4.57 A Line Insulation Breakdown Test Circuit, common to four test positions, applies 200-volt test battery to the line under control of key BT2 or BT1. While the circuit is in use at one position, access to the circuit is denied other positions of the group. Lamp BT lighted steadily (lead D) indicates to all positions in the group that the circuit is in use.

4.58 Key BT2 applies the test to both the tip and ring conductors. Key BT1 applies the test to the ring conductor with key REV (PRI) normal, and to the tip conductor with key REV (PRI) operated. Key BT2 operated operates BD to ground in the Breakdown Circuit (lead G).

(a) BD operated:

- (1) Locks in series with a relay in the Breakdown Circuit (lead H), which opens the ground on lead G.
- (2) Transfers the tip and ring conductors to the Breakdown Circuit (leads B and A).

(3) Opens lead H to succeeding positions of the group.

(4) Operates BD2.

(b) BD2 operated:

(1) Opens the positive meter test lead and the 800-ohm (1.2-mA) meter connection.

(2) Connects the 480-mA Meter Circuit to the Breakdown Circuit (lead F).

(3) Connects ground to the Breakdown Circuit to start the test cycle (lead C).

(4) Transfers lamp BT from steady to interrupted battery as an indication that the test is being applied (leads D and E).

4.59 Key BT1, operated, operates BD1 to ground in the Breakdown Circuit (lead G).

(a) BD1 operated:

(1) Operates BD.

(2) Locks in series with a relay in the Breakdown Circuit (lead H), which opens the ground on lead G.

(3) Grounds lead J to prepare the Breakdown Circuit for applying the test to the ring conductor only (lead A).

(b) BD operated:

(1) Transfers the tip and ring conductors to the Breakdown Circuit (leads B and A).

(2) Opens lead H to succeeding positions of the group.

(3) Operates BD2.

(c) BD2 operated:

(1) Opens the positive meter test lead and the 800-ohm (1.2-mA) meter connection.

(2) Connects the 480-mA meter circuit to the Breakdown Circuit (lead F).

(3) Connects ground to the Breakdown Circuit to start the test cycle (lead C).

(4) Transfers lamp BT from steady to interrupted battery as an indication that the test is being applied (leads D and E).

4.60 When the Breakdown Circuit completes its cycle, the locking path for BD2 is opened, BD2 releases, and lamp BT lighted steadily (lead E) indicates that the

test has been completed. Release and re-operation of key BT2 or BT1 repeats the test. Key BT2 or BT1 released restores the circuit to normal after test cycle has been completed.

"TOUCH-TONE" STATION TESTS

4.61 To make TOUCH-TONE station tests, the tester calls the customer in the normal manner using the primary cord. After explaining what the customer should do during the test, the tester operates the TT key. The TT key operated transfers the sleeve of the test cord to low resistance positive battery. The resultant high positive sleeve current activates the TOUCH-TONE frequency test Applique Circuit, or equivalent, which then transfers the customer line to an input of the TOUCH-TONE Frequency Test Connector Circuit, or equivalent. That circuit, in turn, connects the customer line to an idle TOUCH-TONE Frequency Test Circuit. The test desk will be bridged across the customer line through a high-impedance monitoring amplifier.

4.62 Dial tone will be heard by both customer and tester during the test. Both will also hear the tone signals as the customer keys the digits. At the end of the test, an audible signal will indicate the success or failure of the test.

4.63 If a test is attempted when all the TOUCH-TONE Frequency Test Circuits are busy, a busy tone will be returned to the test desk only.

4.64 Upon completion of the test, the tester restores the TT key. This returns the sleeve current to its normal low negative value which results in re-establishment of the direct connection from test desk to the customer line.

"TOUCH-TONE" CALLING (FS 10)

4.65 When the 4X4 key is operated, the path through the dial pulse contacts, and A transformer in the Telephone Circuit is disconnected and in its place the output of the MF Keyset Circuit is added. Also, when option ZT is provided, operation of 4X4 key closes a path across leads ST and ST1 to start the Tone Generator Circuit. Under this condition, TOUCH-TONE calling signals, instead of mechanical dial pulses, can be transmitted by operating the digit keys in the keyset.

4.66 This feature is available in place of mechanical dialing in all its applications except where a DIAL key is operated. The tester will not be able to monitor while the 4X4 key is operating, nor will the outgoing TOUCH-TONE calling signals be heard. This signaling feature is not provided for use in the remote testing mode.

UNIGAUGE

4.67 When testing on extended range unigauge lines is provided, the tester establishes a call in the normal fashion. All tests may then be performed in the usual manner except talking and the application of receiver off-hook tone. In addition, he must listen for a spurt of tone that identifies a unigauge call.

4.68 Assuming the primary cord had been used and a station is to be rung followed by talking, keys RCCI, X, and T (primary) should be operated. Then operating the appropriate secondary ringing key causes relay RT in the Secondary Ringing Circuit to operate and disable the Telephone Circuit while ringing is applied on the primary cord.

4.69 The associated Test Trunk Ringing Circuit in the central office will previously have shifted from normal ringing and tripping battery to that required for long loop operation under control of a relay LL. The ringing then applied at the local test desk will cause the Test Trunk Ringing Circuit to apply long loop ringing to the subscriber line.

4.70 When the subscriber answers, ringing is tripped in the Test Trunk Ringing Circuit. That circuit will then place a dc bridge and a momentary tone, HT1, on the T and R leads to the Secondary Ringing Circuit.

4.71 The dc bridge on the T and R leads will trip ringing in the Secondary Ringing Circuit. Relay RB operating in that circuit will cause relay UTC to operate and prepare the Telephone Circuit for the spurt of tone that will indicate the call is to a long loop subscriber line.

4.72 Relay UTC operated will:

- (a) Close a path for operating the cut-through relay CT in the Telephone Circuit.
- (b) Bridge leads T3 and R3 to the Telephone Circuit to close a path to the transformer in that circuit.
- (c) Close a path around contacts of the T (SEC) key in the T1 and R1 leads to the Telephone Circuit.

4.73 Relay RT releasing in the Secondary Ringing Circuit will reconnect the cord to the Telephone Circuit. The unigauge tone will be heard just prior to the lighting of lamp TR in the Secondary Ringing Circuit which indicates ringing has been tripped.

4.74 Releasing the ringing key will cause relay UTC to release. Releasing key X will restore use of the primary cord.

4.75 Operating key REX then will:

- (a) Connect +48 volts to the tip and -48 volts to the ring of the primary cord

through resistance lamp PRL to raise the subscriber's talk battery to 96 volts. Resistance lamp PRL provides overcurrent protection for the meter.

(b) Close a path for operating relay ROHU during receiver off-hook tone application.

(c) Operate relay REX to switch in an amplifier that provides 5-dB gain to the Telephone Circuit.

(d) Ground lead REX to the Remote Test Circuit-Near End, if provided, and to the Secondary Ringing Circuit to condition those circuits for long loop operation.

4.76 When the primary cord is being used and key X is operated, relay UTC in operating permits the unigauge tone to be heard with only the primary talk key operated.

4.77 When the secondary cord is used initially and the secondary talk key is operated, relay UTC operated serves no useful function. However, when the unigauge tone has been heard and talking is required, the primary cord circuitry must be used to raise the subscriber's talk battery to 96 volts. To effect this transition to the secondary cord, keys RCCI, T (PRI), REX, and X must be operated.

4.78 When receiver off-hook tones is to be applied to the unigauge line, the secondary cord must be used. Key REX must be operated before key H is operated to apply ROH tone and to operate relay ROHU.

4.79 Operated relay ROHU will raise the subscriber's talk battery, applied with the secondary cord, to 96 volts. This is done by placing +48 volts on the tip lead through resistance lamp SRL to combine with the existing -48 volts on the ring lead.

4.80 The tester will be able to talk to the subscriber, if necessary, after the ROH tone is removed. Thermistor H1 is used to delay relay H1 from operating until after relay H. This prevents a race condition that might occur and prevent the application of ROH tone.

4.81 When remote testing is provided, relay RT in operating will prevent relay REX from operating when key REX is operated. This will prevent connecting the 5-dB amplifier to the Telephone Circuit of this circuit, as a 5-dB amplifier in the Remote Testing Circuit will be used. The tester will know it is an extended range loop by hearing the unigauge tone or consulting the line record card.

4.82 When answering an incoming call from a unigauge line, a spurt of tone will be heard as soon as the cord is inserted into the trunk jack. Key REX is to be operated and the circuit will perform as previously described.

4.83 When testing on a plugged-up line or MDF test trunk, the line record card must be consulted to determine whether the line is an extended range loop. If connection is made to a permanent signal holding trunk and an interrupted tone is heard, this indicates that the circuit is associated with an extended range loop.

5. SECONDARY TEST CIRCUIT, REMOTE TESTING NOT USED

5.01 When a connection to a subscriber line is established with the secondary cord, testing features are provided as covered below.

RECEIVER OFF-HOOK TONE (OPTION ZC AND ZG)
(FS 14)

5.02 Means for signaling a subset in the off-hook condition are provided by a Howler Circuit, common to four test positions, under control of key H. While the circuit is in use at one position, access to the circuit is denied to other positions of the group. Lamp H lighted steadily (lead B) indicates to all positions in the group that the circuit is in use.

5.03 With the subset in the off-hook condition, relay S operates and operates relay SRL. Relay SRL operated: (a) extinguishes lamp S (off-hook supervision), (b) opens the operating path for relay H1, (c) closes, in part, a locking path for relay H, and (d) closes, in part, an operating path for relay H.

5.04 Key H operated: (a) disconnects the tip and ring conductors from key X to prevent transfer of the Howler Circuit to the primary test cord, (b) closes the locking path for relay H1, and (c) operates relay H to ground in the Howler Circuit (lead E).

5.05 Relay H operated: (a) locks under control of key H and relays H1 and SRL, (b) starts the Howler Circuit (leads F and G), (c) opens the battery path to succeeding positions, (d) connects the tip and ring conductors, through transformer S, to the howler tone, (leads D and C), and (e) transfers lamp H from steady to interrupted battery in the Howler Circuit (leads B and A). Lamp H, flashing, indicates that howler tone is being applied to the line.

5.06 When the Howler Circuit completes its graduated tone cycle, lamp H lights steadily (lead A) to indicate completion of the test. Release and reoperation of key H repeats the cycle.

5.07 Restoration of the subset to the on-hook condition releases relays S and SRL. Relay SRL released: (a) lights lamp S (on-hook supervision), (b) opens the operating path and locking path for relay H, (c) releases relay H, and (d) operates relay H1.

5.08 Relay H1 operated: locks under control of key H and opens the operating and locking path for relay H. Key H released

restores the circuit to normal at any stage of the test.

RECEIVER OFF-HOOK TONE (OPTION ZD AND ZG) (FS 14)

5.09 Means for signaling a subset in the off-hook condition are provided by a Timer Circuit which, in turn, is connected to a receiver off-hook tone generator. Each position has its own timer connections and operates independently of any other position, in contrast to the old howler arrangement. Application of receiver off-hook tone is under control of the H key as follows.

5.10 Connection to the subscriber line is established over the secondary test cord. The subset off-hook operates relay S which, in turn, operates relay SRL. Relay SRL operated: (a) extinguishes lamp S (off-hook supervision), (b) opens the key controlled operating path for relay H1, (c) closes, in part, a locking path for relay H, and (d) closes, in part, an operating path for relay H.

5.11 Key H operated: (a) disconnects the tip and ring conductors from key X to prevent transfer of the receiver off-hook tone to the primary test cord, (b) closes the locking path for relay H1, and (c) operates relay H.

5.12 Relay H operated:

- (a) locks under control of key H and relays H1 and SRL.
- (b) grounds the ST leads to start the Timer Circuit.
- (c) Connects the tip and ring conductors through transformer S and two 432-ohm resistors to the Timer Circuit.
- (d) Transfers lamp H to interrupted ground from an interrupter circuit.
- (e) Grounds lead ST to the interrupter circuit when required.

5.13 The H lamp flashes and the Timer Circuit applies receiver off-hook tone over leads T and R until it times out or until the subset returns to on-hook. When the timer ends its cycle, it operates relay H1 by grounding lead EC. Relay H1 operated:

- (a) Closes, in part, a path to light lamp H steadily.
- (b) Locks under control of key H.
- (c) Opens the operating path of relay H.
- (d) Opens the lockup path of relay H, causing it to release.

5.14 Relay H released:

- (a) Removes ground from the ST lead to the interrupter circuit.
- (b) Removes ground from the ST lead to the Timer Circuit.
- (c) Disconnects the Timer Circuit from the tip and ring conductors.

- (d) Completes a ground path to light lamp H steadily.

5.15 Release of key H releases relay H1 and extinguishes lamp H. Reoperation of key H restarts the entire cycle.

5.16 If, during the application of receiver off-hook tone, the subset changes to on-hook, relay S will release. Relay SRL will then release. Relay SRL released:

- (a) Lights lamp S (on-hook supervision).
- (b) Opens the operating and locking paths for relay H, thereby releasing relay H.
- (c) Operates relay H1 under control of key H.

5.17 Relay H released:

- (a) Releases the Timer Circuit and the interrupter circuit by removing ground from the ST leads.
- (b) Disconnects the timer from the tip and ring conductors.
- (c) Closes, in part, a ground path to light lamp H.

5.18 Relay H1 operated:

- (a) Completes ground path to light lamp H steadily.
- (b) Locks under control of key H.
- (c) Opens the operating and locking paths for relay H.

5.19 Key H released will restore the circuit to normal at any stage of the receiver off-hook tone application.

RECEIVER OFF-HOOK TONE (FS 14) (OPTION ZD AND ZH) - REMOTE TESTING NOT USED

5.20 FS 14 provides control for a means of signaling a subset in the off-hook condition. This FS with option ZH can be used either with or without remote testing. The description here is for nonremote testing. This FS provides for connection to a Timer Circuit which, in turn, has connections to a receiver off-hook tone generator. Each position has its own timer connections and operates independently of any other position. Application of receiver off-hook tone is under control of the H key as follows.

5.21 Connection to the subscriber line is established over the secondary test cord. The subset in off-hook condition operates relay S which, in turn, operates relay SRL. Relay SRL operated:

- (a) Extinguishes lamp S (off-hook supervision).
- (b) Opens the operating path for relay H1.
- (c) Closes, in part, an operating path for relay H.

5.22 Key H operated:

- (a) Disconnects the tip and ring conductors from key X to prevent transfer of

the receiver off-hook tone to the primary test cord.

(b) Operates relay H.

(c) Applies ground to lead H to remote testing circuit, but this performs no useful function at this time.

5.23 Relay H operated:

(a) Locks under control of key H.

(b) Grounds the ST lead to start the Timer Circuit.

(c) Connects the tip and ring conductors through transformer S and two 432-ohm resistors to the Timer Circuit.

(d) Transfers lamp H to a lead to interrupted ground from an interrupter circuit, causing the lamp to begin flashing.

(e) Grounds lead ST to the interrupter circuit when required.

5.24 The above status will be maintained until the timer times out (about 1 minute), the subset is returned to on-hook, or the H key is restored.

5.25 When the timer times out, it applies ground to the EC lead, operating relay H1. Relay H1 operated:

(a) Locks up to ground through diode CR13 under control of key H.

(b) Releases relay H.

(c) Partially closes a ground path to light the H lamp steadily.

5.26 Relay H released:

(a) Transfers the H lamp from interrupted ground to steady ground, under control of relay H1, to light lamp H steadily.

(b) Disconnects the subscriber line from the Timer Circuit.

(c) Releases the Timer Circuit and interrupter circuit by removing ground from their ST leads.

5.27 If the subset is returned to on-hook during the application of tone, the SR1 relay will release. This will apply ground through diode CR13 and break contacts of relay RT to the winding of relay H1, causing relay H1 to operate. The sequence from this point on is the same as described above where the H1 relay was operated over the SC lead.

5.28 Release of the H key at any time will restore the circuit to normal by releasing the H or H1 relay. If for any reason the H key is operated while the subset is on-hook, ground will be applied to the winding of relay H1 through diode CR13 and break contacts of relays RT and SR1, and relay H1 will operate. Relay H1 operated, lights lamp H steadily and opens the operating path of relay H. This will prevent the application of tone to the subscriber line

in the event the subscriber subsequently lifts the receiver, thereby operating relay SR1.

DIAL SPEED TEST

A. Dial Speed Tests Using the Test Desk Meter (FS 12)

5.29 The dial testing circuit, common to four test positions, in conjunction with the test desk meter, provides means for testing the speed of subset dials under control of keys DIAL TEST, SET 10, and SET 18. Key SET 10 or key SET 18, in conjunction with the rheostat feature, permits calibration of the dial testing circuit to indicate the speed of low- or high-speed dials, respectively. Key DIAL TEST prepares the Dial Test Circuit to receive dial pulses.

5.30 Key SET 10 closes, in part, a path from the 20,000-ohm meter terminals (24 volts) through resistor TA for low-speed dial calibration (leads M and S).

5.31 Key SET 18 closes, in part, paths from the 20,000-ohm meter terminals (24 volts) through resistors TB and TC for high-speed dial calibration (leads A, B, M, and S). Key SET 10 or SET 18 operated:

(a) Closes a path for the operation of the Flashing Circuit, when provided.

(b) Connects ground to lead G and closes, in part, a path for ground to lead C to prepare the Dial Test Circuit for calibration.

(c) Operates relay DT.

5.32 Relay DT operated:

(a) Connects start ground to the Flashing Circuit, when required.

(b) Transfers the tip and ring conductors to the dial testing circuit (leads T and R).

(c) Connects interrupted battery to flash lamp DT as an indication that the dial testing circuit is connected.

(d) Connects steady battery to lamps DT in the other positions of the group as an indication that the dial testing circuit is in use.

(e) Completes the ground path to lead C.

(f) Operates relay DT1.

5.33 Relay DT1 operated:

(a) Connects the 20,000-ohm meter terminals (24 volts) for calibration of the Dial Test Circuit under control of key SET 10 or SET 18 (leads A, B, M, and S).

(b) Closes, in part, a path to the 800-ohm meter terminals (1.2 mA) to indicate dial speed (leads D and M).

(c) Clears other meter terminals.

5.34 Key RHE operated connects the rheostat in series with the meter connection to the Dial Test Circuit (lead B). Using the 24-volt meter scale, the Dial Test Circuit is calibrated by adjusting the rheostat to obtain a reading of 10 volts for a low-speed dial (key SET 10) or 18 volts for a high-speed dial (key SET 18).

5.35 Key DIAL TEST operated transfers ground from lead C to lead DT and connects the 1.2 mA (800 ohm) meter terminals to the output of the Dial Test Circuit (leads M and D).

5.36 When the Dial Test Circuit is prepared to receive dial pulses, dial tone is connected to the tip and ring conductors.

5.37 When a digit is dialed at the subset, dial pulses are indicated on the 0 to 24 meter scale. At the completion of pulsing the meter returns to 0. The meter deflection obtained just prior to the completion may be read directly on the 0 to 24 scale as pulses per second.

5.38 Key DIAL TEST, released and reoperated, prepares the circuit for a repeat test. Release of key DIAL TEST and SET 10 or SET 18 restores the circuit to normal.

5.39 Calibration and pulse timing are explained in the circuit description for the dial testing circuit.

B. Dial Speed Tests Using the 51-Type Dial Tester (FS 13)

5.40 Key LSDT or HSDT establishes a connection to an idle dial tester and prepares the dial tester for testing low- or high-speed dials, respectively.

5.41 Key TEST or ADJ prepares the dial tester to apply test or adjust limits, respectively, to the dial. Key LSDT or HSDT operated:

- (a) Connects ground to lead ST to summon an idle dial tester.
- (b) Connects battery through resistor HG to lead HG.
- (c) Prepares a path for the operation of relay DT1 over lead DT.
- (d) Closes a path for operation of the Flashing Circuit.
- (e) Closes lead SP through to keys TEST and ADJ.

5.42 Ground on lead ST causes all idle dial testers to hunt for the position. Battery on lead HG stops the first dial tester to reach the position. Battery from the dial tester over lead TD operates relay DT1. Relay DT1 operated:

- (a) Removes ground from lead ST.
- (b) Removes battery from lead HG.
- (c) Connects interrupted battery to lead DT to flash lamp DT as an indication that the position is connected to a dial tester.

5.43 If all dial testers are busy, battery is connected to lead PL, and lamp DT is lighted steadily. Key TEST or ADJ operated operates relay DT. Relay DT operated:

- (a) Transfers the tip and ring conductors to the dial tester (leads T and R).
- (b) Connects ground to operate the Telephone Circuit monitoring relay (lead SM).
- (c) Connects the ring conductor to the Telephone Circuit (lead RM).

5.44 Preparation of the dial tester is controlled over lead SP as in Table C.

TABLE C

Type of Dial	Limits	Keys	SP LEAD	
			W Option	S Option
High Speed	Test	HSDT, TEST	Battery	Ground
	Adjust	HSDT, ADJ	Ground	Ground
Low Speed	Test	LSDT, TEST	Open	Open
	Adjust	LSDT, ADJ	5000-Ohm Ground	3200-Ohm Ground

5.45 The subset dial bridge sets the Dial Tester Circuit to receive dial pulses. The dial tester connects dial tone to the tip and ring conductors and connects battery to lead HL to operate relay M.

5.46 Relay M operated completes the monitoring connection to the Telephone Circuit (lead TM). Dialing the digit 0 causes the dial tester to release relay M during pulsing and to measure the speed of the dial. At the completion of pulsing, relay M is operated and a distinctive tone, indicating the dial speed, is connected to the tip and ring conductors.

5.47 Detailed operation is covered in the circuit description for the 51-type dial tester.

CONDUCTOR IDENTIFICATION (FS 20)

5.48 The conductor identification feature consists of a tone connection and supervisory relay TN. With tone connected at the central office end, a conductor may be identified at the distant end. Relays TN and TN1 and buzzer B provide an audible signal at the test desk under control of key BG to indicate the condition at the distant end of the conductor.

5.49 Key S operated:

- (a) Transfers the tip and ring conductors from the transformer and supervisory feature to ground and the tone feature, respectively.
- (b) Operates relay TN2.

5.50 Relay TN2 operated provides start ground to the Tone Circuit when required (lead ST).

5.51 When key S is operated and key BG is normal, tone can be heard at a handset connected from the ring conductor to ground or bridged across the tip and ring conductors.

5.52 Grounding the ring conductor or bridging the tip and ring conductors operates relays TN and TN1. Relay TN1 connects ringing current to the buzzer to provide an audible signal at the test desk.

5.53 Key BG operated switches the buzzer connection to provide an audible signal when the line is clear and to silence the buzzer while the ring is grounded or the tip and ring are bridged. Key REV (SEC) operated, in conjunction with the above, reverses the tip and ring conductors.

5.54 Cord SO provides a separate connection for the identification tone and buzzer signal, leaving the Secondary Test Circuit free for other use.

6. ESTABLISHING TEST CONNECTIONS USING REMOTE TESTING CIRCUITS (OPTION 2H)

GENERAL

6.01 When Remote Testing Circuits are used, a number of changes in functions and procedures take place. Briefly, and probably oversimplified, this is what happens. The keys of this circuit are used, via the Remote Testing Circuits, to control a sort of relay equivalent of this circuit in the distant office. Measurements and supervisory signals from that circuit are telemetered back via the Remote Testing Circuits and displayed on the meter and lamps in this circuit.

6.02 The Remote Testing Circuits at the test desk to which this circuit connects directly are the Remote Testing Circuit - Near End (referred to henceforth as the near-end RTC) and the Near End Test Trunk or Line Circuit. In the distant office is the Remote Testing Circuit - Far End (henceforth referred to as far-end RTC), which includes the relay equivalent of the primary and secondary test circuit. It connects to conventional regular or no-test incoming Test Trunk Circuits, test trunk and selector circuits, or MDF test trunks designed to work with the No. 14 local test desk.

6.03 The Remote Testing Circuits at the test desk are connected to the far-end RTC at the distant office over a voice frequency path that may be either a dedicated facility or one randomly selected by a switching system. In the latter case, the path must be established before any testing can be done. When nondedicated facilities are used, access to the far-end RTC is via

the Far End Test Trunk Circuit or Line Circuit in the remote office.

ACTIVATING REMOTE TESTING CIRCUITS

6.04 When dedicated facilities are used between the test desk and the distant office, all that is necessary for activation is to plug the primary test cord into an idle test trunk to the distant office. The secondary test cord is not used with remote testing.

6.05 When nondedicated facilities are used, an idle test trunk to the distant office is noted. Using the position telephone circuit and a suitable trunk key, the testman dials the telephone number assigned to the Far End Test Trunk Circuit or Line Circuit associated with the idle test trunk. Shortly thereafter, the supervisory lamp in the test trunk should flash, indicating the far-end test trunk in the distant office has called back to the test desk over the facility selected by the switching system. The testman then completes the setup by plugging the primary test cord into the trunk jack. The line circuit used for dialing the telephone number can now be released.

6.06 When the primary test cord is inserted into the remote testing trunk jack in either case described above, a short pulse of negative 130-volt battery from the near-end test trunk momentarily operates the SL relay in this circuit over the sleeve lead of the test cord. Relay PS also operates, but this serves no useful purpose. Operation of relay SL operates relay SL in the Remote Testing Circuit-Near End over lead SL.

6.07 In the near-end RTC the momentary operation of relay SL operates SL1. When relay SL releases, it starts the release of slow-release relay SL1. During the interval of relay SL released and relay SL1 still operated, negative 48-volt battery is connected to lead RT1 to operate relay RT in the primary and secondary circuits (FS 1). Relay RT operated:

- (a) Operates relay RT1.
- (b) Transfers the sleeve of the primary test cord to the winding of relay RT. Negative 48-volt battery through marginal relay TT in the test trunk holds relay RT operated (FS 1).
- (c) Grounds lead RT to operate relay PC in the near-end RTC.
- (d) Opens the 24V, 1.2MA meter lead (FS 9).
- (e) Transfers the tip and ring conductors of the primary test cord to the near-end RTC (FS 1).
- (f) Opens part of the operating path of relay H1 in FS 14.

- (g) Opens lead X to the MF Keyset Circuit, if provided.
- (h) Opens a ground lead to transformer P, to prevent noise from entering the Telephone Circuit.

6.08 Relay RT1 operated:

- (a) Transfers control of primary supervisory lamp P to the near-end RTC over lead LP (FS 1).
- (b) Transfers contact 5D of key M (PRI) from lead M to lead A to the Telephone Circuit via diode CR18, and to the TK relay via diode CR17. Thus, operation of key M (PRI) will operate the TK relay and condition the Telephone Circuit for talk and listen condition. Monitoring with remote testing facilities is performed with the Telephone Circuit in the talking and listening condition, in order to provide a proper terminating impedance at the test-desk end of the transmission facility. At the distant office, the monitoring path is established through a high-impedance one-way monitoring amplifier.
- (c) Transfers the dialing portion of this circuit from its normal connection with the primary and secondary test cords, to leads T1 and R1, to the near-end RTC (FS 3).
- (d) Opens meter leads 480MA; 24V, 24MA; 60V, 1.2MA, and 120V, 1.2MA.
- (e) Transfers meter leads 1.2MA (including fuse M) and, from this circuit to the near-end RTC (FS 9).
- (f) Connects leads T and R from the near-end RTC to this circuit to establish the transmission path for talking, listening, and monitoring (FS 10).

6.09 At this point, the remote testing facilities are activated and the test desk is now connected to a regular (or non-no-test) incoming test trunk. If desired, the test connection can be transferred to a no-test incoming test trunk, MDF test trunk, or test trunk and selector circuit by operating, respectively, the NT, MDF, or TS key at the test desk. Where only no-test incoming test trunks are provided, an optional arrangement permits direct connection to them without having to operate the NT key.

TEST TRUNKS USING DIAL TERMINATING EQUIPMENT (FS 3)

6.10 After establishing the connection to the incoming test trunk as described in 6.04 to 6.09, the subscriber line connection can be established as follows.

6.11 If the subscriber line number is in the extra number series in a No. 1 crossbar office, operation of REV (PRI) key is required before the DIAL (PRI) key is operated. This grounds lead RV, through diode CR16, to the near end RTC which, in turn, sends the reverse order to the distant office. There the reverse will condition

the incoming test trunk for a number in the extra number series (FS 1).

6.12 With REV (PRI) key operated or normal, as required, the DIAL (PRI) key is operated. This operates relay DB through diode CR3 and grounds lead DL through diode CR4, to the near-end RTC.

6.13 The near-end RTC then prepares for dialing. Operation of relay DB operates relay NP, which locks up to battery through resistor C. When relays DB and NP are both operated, relay DA operates and locks under control of relay NP. Operation of relay DA operates relay D. The near-end RTC lights lamp P.

6.14 Operation of relay D disconnects the dial from the Telephone Circuit and bridges it, in series with the DE relay, across leads T1 and R1 to the near-end RTC.

6.15 When the terminating equipment at the distant office is ready to receive dial pulses, the P lamp will be extinguished. The proper digits are then dialed to select the desired test trunk (through the test trunk and selector circuit) or subscriber line as described previously without remote testing. At this point, if lamp P lights it indicates one of the following:

- (a) A connection to a subscriber line has been established in other than a step-by-step office.
- (b) In a step-by-step office, a connection has been established to a busy subscriber line.

6.16 When a connection to a subscriber line has been established, operation of the M (PRI) key before releasing the DIAL (PRI) will prepare the circuit for monitoring (this will prevent interference with a subscriber's use of the line if a connection has been established to a busy line).

6.17 Release of DIAL (PRI) key releases relay DB and removes ground from lead DL. Release of relay DB shunts relay NP, causing it to release. Relay NP released in turn releases relay DA. The Remote Testing Circuits restore from the dialing status when the ground is removed from the DL lead.

6.18 In a step-by-step office after a test connection has been established, reoperation of DIAL (PRI) key reestablishes the dialing condition. The test connector can then be advanced to another line on the same level by dialing the proper digit. Release of the DIAL (PRI) key restores the circuits to the test condition.

PERMANENT SIGNAL RELEASE (STEP-BY-STEP OFFICE) (FS 2)

6.19 In a step-by-step office, when a connection has been established to a subscriber line in a permanent signal condition, it may be possible to effect a

release if the test train is equipped for permanent signal release. In this case, the release is attempted by operating the PS RLS key.

6.20 The PS RLS key operated grounds lead PR to the near-end RTC, causing it to send the corresponding order to the distant office. There, the far-end RTC sets itself up for the permanent signal release condition and performs the following:

- (a) Opens the sleeve lead to the Test Distributor Control Circuit.
- (b) Connects negative battery through relay RL winding to the tip lead to the Test Distributor Control Circuit.
- (c) Connects resistance negative battery to the ring lead to the Test Distributor Control Circuit.

6.21 As soon as the terminating circuits attempt the release, interrupted ground will be returned to the far-end RTC over the tip lead. The near-end RTC thereupon flashes the P lamp as an indication that the release is being attempted.

6.22 Failure of the first selector or connector to release causes the ground on the tip lead to become steady. The resulting steady lighting of lamp P indicates the failure of the attempted release.

6.23 Release of the first selector or connector causes the interrupted ground to be removed from the tip lead. The resultant extinguishing of the P lamp indicates the success of the release attempt.

6.24 Restoral of PL RLS key restores all involved circuits to the normal test condition.

TEST TRUNKS USING MF PULSING TERMINATING EQUIPMENT (FS 1)

6.25 After establishing the connection to the incoming test trunk as described in 6.04 to 6.09, the subscriber line connection can be established as follows.

6.26 If the subscriber line number is in the extra number series in a No. 1 crossbar office, operation of the REV (PRI) key is required before the KP (PRI) key is operated. This grounds lead RV (through diode CR16) to the near-end RTC which, in turn, sends the reverse order to the distant office. There, the reverse will condition the incoming test trunk for a number in the extra number series.

6.27 With the REV (PRI) key operated or released as required, the KP (PRI) key is operated. This conditions the MF Keyset Circuit, near-end RTC, far-end RTC, etc for MF keypulsing. For details of MF keypulsing, refer to the circuit diagram for the MF Keyset Circuit.

6.28 After keypulsing has been completed, operation of M (PRI) key before restoring the KP (PRI) key will eliminate

interference with a call in progress if a connection has been established to a busy line. Restoration of the KP (PRI) and REV (PRI) keys restores all circuits to normal testing condition.

TEST TRUNKS (IN-AND-OUT TYPE) TO MDF, JACK PANEL, OR TOLL TESTBOARD

6.29 The remote testing circuits are activated and connection is established to a regular incoming test trunk as described in 6.04 to 6.09. Then the MDF key is operated to transfer the test connection from the regular incoming test trunk to the MDF trunk. From this point on, the use of the trunk is the same as described without remote testing, except that the P lamp does not light at any time.

7. REMOTE TESTING

TALKING AND MONITORING (FS 1, 10, 11)

7.01 The talking connection is established by operating the T (PRI) key. The T (PRI) key operated:

- (a) Grounds lead TK (through CR2) to the near-end RTC. This causes the Remote Testing Circuit to establish the talking connection. The transmission path is from the position Telephone Circuit to this circuit over leads T and R; then, from this circuit to the near-end RTC over leads T and R (FS 10); from the near-end RTC to the far-end RTC over the remote testing transmission path; and then to the subscriber line.
- (b) Grounds lead A to the Telephone Circuit to enable it by operating its cut-through relay.

7.02 When talking battery is required for the tip and ring to the subscriber line, key RCCI is operated; this grounds lead RC to the near-end RTC. The near-end RTC orders the far end RTC to then connect talk battery through a supervisory relay winding. The far-end RTC also connects the telemetering circuit (480-mA full scale deflection) in series with the ring lead. This allows the measurement of transmitter current. A difference with remote testing is that the metering circuit is disabled when the T (PRI) key is operated.

7.03 The monitoring connection is established by operating the M (PRI) key. The M (PRI) key operated:

- (a) Grounds lead A through diode CR18 to the position Telephone Circuit and operates relay TK through diode CR17 to enable the Telephone Circuit in the talking condition. The talking condition is used for monitoring when remote testing is used.
- (b) Grounds lead M to the near-end RTC. This causes the remote testing circuits to establish the monitoring condition.

7.04 In the far-end RTC, the high-impedance input of the monitoring amplifier is bridged across the tip and ring leads to the subscriber line. The output of the amplifier feeds toward the testman through the remote testing transmission path, the near-end RTC, and to the Primary and Secondary Test Circuit over leads T and R (FS 10). From here, the path is to the Telephone Circuit over leads T and R (FS 10).

7.05 After connection to a subscriber line has been established, as described in 6, testing features are provided as follows.

TEST BATTERY, METER, AND SCALE CHANGE KEYS (FS 9)

7.06 Test battery for the Primary Test Circuit is provided through scale change keys and the meter as indicated in Table D.

TABLE D

Keys Operated	Full Scale Deflection	Battery Voltage	Metering Resistance
		volts	ohms
None	120V	+100	100,000
60V	60V	+50	50,000
24 ma	24V	+20	1,000
RCCI	480 ma	-48*	4

*Central office battery is used for -48 volt supply.

7.07 In this circuit the galvanometer winding of the meter is connected to the near-end RTC. It functions as a milliammeter with a full scale deflection of 1.2 ma. The meter current is supplied from the telemetering system in the Remote Testing Circuits. The test battery voltages and meter scale changing resistances are provided in the far-end RTC in the distant office. There the Metering Circuit has, in place of the 1.2-mA meter winding, a control winding in the current-controlled oscillator.

7.08 Operation of the metering keys listed in Table D ground corresponding leads to the near end RTC. This results in operation of corresponding relays in the distant office to perform the appropriate function.

TESTS USING THE METER CIRCUIT (FS 9, 11)

A. Tests for Bridged and Grounded Conductors

7.09 With the scale change keys (Table D) operated as required and all test keys normal (except keys NT, MDF, or TTS which may be operated if required), test battery through the telemetering system is connected to the ring conductor. A grounded ring conductor is indicated by a steady deflection of the meter.

7.10 With the REV (PRI) key operated, the test is applied to the tip conductor. The operated key grounds the RV lead through CR16 to the near-end RTC, which causes the tip and ring leads to be reversed at the distant office.

7.11 Operation of the G (PRI) key grounds lead G to the near-end RTC. This causes the far-end RTC in the distant office to connect ground to the tip conductor. With the test battery being applied to the ring conductor, a meter deflection will indicate a bridge across tip and ring conductors.

7.12 Operation of the FEMF key grounds lead F to the near-end RTC. This causes the far-end RTC to connect the Telemetering Circuit between the ring conductor and ground. Negative foreign potential on the ring conductor is indicated by a forward steady deflection on the meter. Positive foreign potential causes the meter to indicate off-scale low.

7.13 Operation of VM REV key grounds lead VR to the near end RTC. This causes the far end RTC to reverse the polarity of the connections to the Telemetering Circuit.

7.14 Operation of the REV (PRI) key allows the foreign potential test to be performed on the tip conductor.

B. Tests for Line Capacity

7.15 Capacity on the line is indicated by a momentary deflection of the meter when keys G (PRI) and REV (PRI) are operated.

C. External Circuit Resistance

7.16 In testing grounded or bridged conductors, the external circuit resistance can be calculated by:

$$\text{EXT CKT RES} = \frac{(V-M)R}{M}$$

where V = test battery voltage, M = voltage reading of the meter, R = metering circuit resistance.

7.17 Selection of metering resistance close to the external circuit resistance gives the most accurate results.

D. Line Identification in Crossbar Offices

7.18 With a test connection established and 3WO (PRI) key operated, line identification is indicated by the meter as shown in Table E.

7.19 In this test, the 3WO (PRI) key operated grounds the 3WO lead to the near-end RTC, which then causes the far-end RTC at the distant office to open the sleeve lead to the incoming test trunk. The open sleeve conditions the trunk for line identification.

TESTING SUBSCRIBER LINE RELAYS (OTHER THAN CROSSBAR OFFICES) (FS 1, 10)

7.20 With a noncoin subset in the on-hook condition and keys T (PRI) and 3WO

TABLE E

Test Indication	Type of Line	
	Crossbar No. 1	Crossbar No. 5
-48V on ring	Ring party, individual line, or last line of hunting group	Ring party or individual line
-24V on ring	-	Ring party or individual line (Uni-gauge)
-48V on tip	Tip Party	Tip party
-24V on tip	-	Tip party (Unigauge)
Direct ground on ring	PBX line in terminal hunting group	PBX hunting line including last line of hunting group
1000 ohm ground on ring	-	PBX hunting line including last line of hunting group (Uni-gauge)

(PRI) operated, the test circuit is set up for an operating test of the line relay.
Key T (PRI) operated:

- Closes, in part, the transformer path of the Telephone Circuit (leads T3 and R3).
- Connects ground to lead A to enable the Telephone Circuit.
- Grounds lead TK, via CR2, to the near-end RTC, which causes the far-end RTC to establish the talking condition in the distant office.
- Operates relay TK which, in turn, completes closure of the transformer path of the Telephone Circuit (leads T3 and R3).

7.21 Operation of 3WO (PRI) key grounds lead 3WO to the near-end RTC. The near-end RTC causes the far-end RTC to open the sleeve lead and places an inductor bridge across the tip and ring leads. The inductor minimizes attenuation of dial tone.

7.22 The combination of open sleeve and bridge should operate the line relay. This will be indicated by an operator answering or by the presence of dial tone.

7.23 Operation of line relay for coin pre-pay subset is the same as above except that the LRP key must also be operated.

7.24 Operation of the LRP key grounds lead LRP to the near-end RTC. This causes the far-end RTC to connect ground through an inductor and resistor to the tip lead. At this time the line relay should operate.

RELAY-TYPE SUBSETS (4-PARTY LINES) (FS 8)

7.25 Operation of key SSRT grounds lead SRT to the near-end RTC. This causes the far-end RTC to connect ringing potential through a transformer and resistor to the tip and ring leads toward the line under test. Test battery through the metering circuit is connected to the ring lead via an inductor.

7.26 The ringing voltage causes the subset relays to operate. Operation of the relays connects the ringers to ground. Now with the 24MA key operated, the deflection of the meter affords a comparative indication of the number of subsets connected to the line.

7.27 Operation of REV (PRI) key allows the above test to be applied to the tip side of the line.

TUBE-TYPE SUBSETS (FS 6)

7.28 Operation of key -STA or +STA grounds lead STA- or STA+, respectively, through diode CR8 or CR6, respectively, to the near-end RTC. This causes the far-end RTC at the distant office to set up test for a negative or positive station.

7.29 In the far-end RTC the setup is similar to that in the test desk when remote testing is not used. The resultant ring side test current is telemetered to the test desk where the meter deflection then affords an indication of the number of subsets connected to the ring side of the line. Operation of the REV (PRI) key permits the above test to be performed on the tip side of the line.

COIN STATION TESTS (FS 5)

A. Coin Relay

7.30 With the hopper trigger tripped in a coin telephone, operation of the coin relay can be verified.

7.31 Operation of CC or CR key disables the Telephone Circuit by opening the enabling ground for lead A, and grounds lead CC or CR, respectively, through diode CR12 or CR10, respectively, to the near-end RTC. The near-end RTC transmits the appropriate order code to the far-end RTC. CC or CR key operation also operates relay CN, out this performs no useful function.

7.32 The far-end RTC, upon receiving the CC or CR order code, connects coin collect or coin return potential through the metering circuit to the tip lead (both tip and ring leads when coin first service is provided) of the line under test.

7.33 The metering circuit is scaled to give a current reading on the 480 mA scale at the local test desk. No adjustments are possible. Only the proper operation of the coin relay can be checked.

B. Coin Relay Ground Closure

7.34 An initial deposit in a 200-type coin station or any deposit in a 1A-type

coin station should cause the hopper trigger to close and apply ground to the coin relay. The presence of that ground can be verified by voltmeter tests on the tip lead as described in 7.09 and 7.10.

C. Chute Magnet

7.35 In 200-type coin stations arranged for dial tone first service and an initial deposit of more than a nickel, a single nickel deposit should be trapped in the coin chute. A diode in parallel with the chute magnet is poled so normal negative talking battery on the ring lead is shunted around the magnet winding.

7.36 After the single nickel deposit no ground should be detected on the tip lead as described in 7.34. Operation of T(PRI) and RCCI keys should not release the nickel. Subsequent operation of the REV key to reverse the current in the loop should allow the magnet to operate and drop the nickel.

D. Ground Removal

7.37 Coin telephones arranged for dial tone first may have a ground removal feature. A relay in the ring lead of the set operates on loop current of either polarity to open the ground path for the coin relay.

7.38 To test this feature have the station personnel deposit a dime or two nickels after waiting a few seconds after the request.

7.39 During the few seconds waiting period, the tester operates the G key and then operates and holds the CR key. The G key and CR key operations ground the G and CR leads to the near-end RTC which then sends the corresponding orders to the far-end RTC. The far-end RTC transfers the tip lead to coin return potential (-130V) through the metering circuit (450 mA scale) and grounds the ring lead through 1800 ohms. The meter at the test desk should indicate a current of over 20 mA. This current is from the coin return potential through the station and back through the 1800 ohms to ground. This is high enough that the ground removal relay should operate.

7.40 When the coins are deposited, the hopper trigger closes to apply ground to the coin relay. If the ground removal relay has operated, the coin relay path will be open and the meter reading will remain steady. If the ground removal relay did not open the ground path, the meter reading will increase by at least 25 mA. Usually the coins will then be returned and the meter reading will return to the original value. In some long loop cases the coins may be held and the meter reading will remain at the new higher value.

7.41 After the deposit and no change in meter reading is noted, the closed hopper trigger can be verified by testing the tip lead for ground as in 7.09 and 7.10.

E. Totalizer Shunt Diode (Option ZP)

7.42 In a 1A type coin station arranged for dial tone first and an initial deposit of over one nickel, a diode shunt around the totalizer prevents a single nickel readout while normal negative talking battery is applied to the ring lead.

7.43 While T and RCCI keys are operated a single nickel deposit should be made. No readout should be heard. Then operate REV key. This causes the far-end RTC to reverse the direction of loop current so the diode should not conduct. A nickel readout should now be heard.

F. SCR and Diode Shunts in Coin Relay Path

7.44 The 1A-type coin telephones arranged for dial tone first have an SCR - diode shunt circuit in parallel with the totalizer contacts in the coin relay path. This circuit permits a single nickel deposit to be collected or returned even though the contacts are open.

7.45 After a single nickel deposit, the totalizer contacts should be open, but a ground should be detected on the tip lead when positive potential is used, and there is only little or no current in the ring lead. For positive potential on the tip either of two diodes across the contacts should conduct. Test as in 7.09 and 7.10.

7.46 With negative potential under about 60 volts on the tip the path should appear open. To test this, operate T, RCCI, and REV keys. These operations cause the remote testing circuits to function as described elsewhere to apply -48 talking battery to the tip and ground to the ring lead. The meter should indicate only normal leakage current. This tests for ground with the -48 volt talking battery.

7.47 Next operate the CR key. This grounds CR lead to the near-end RTC which sends the order code to cause the far-end RTC to apply -130 volts to the tip lead through the metering circuit (480 mA scale). The high negative potential should break down a zener diode and trigger the SCR on. The test desk meter should kick upward while the coin is being returned.

RECEIVER OFF-HOOK TONE (OPTION ZD AND ZH) (FS 14)

7.48 FS 14 provides control for a means of signaling a subset in the off-hook condition. This FS with option ZH can be used either with or without remote testing. The description here is for use with remote testing. Means are provided for connection to a Timer Circuit which, in turn, is connected to a receiver off-hook tone generator. One Timer Circuit and generator are connected at the far-end RTC and one Timer Circuit and generator are connected at the test desk. At the test desk, some features of the Timer

Circuit are used, but the generator serves no useful purpose when remote testing is used. The primary test cord is always used with remote testing, whereas, when remote testing is not used, the receiver off-hook tone is associated with the secondary cord.

7.49 After connection to the subscriber line has been established, the H key is operated. This grounds the H lead, through CR14, to the near-end RTC, causing the Remote Testing Circuit to prepare for receiver off-hook tone application to the line. In the near-end RTC relay H operates from the ground on lead H. At this time, relay S will be released and ground is returned to this circuit over lead HS, causing relay SR1 to operate. The near-end RTC extinguishes lamp P to indicate the off-hook condition. This sequence always occurs whether the subset is on-hook or off-hook. After a short delay the SR1 relay will release if the subset is on-hook. It will remain operated if the subset is off-hook. Relay SR1 operated:

- (a) Opens the key controlled operating path for relay H1.
- (b) Closes the operating path for relay H, which then operates.

7.50 Relay H operated:

- (a) Locks under control of key H and relay H1.
- (b) Grounds the ST lead to start the timer.
- (c) Connects lamp H to interrupted ground over a lead to the Interrupter Circuit.
- (d) Grounds lead ST to start the interrupter, when required.
- (e) Partially closes the key controlled operating path for relay H1 (the path through relay RT is open because the relay is operated during use of the remote testing mode).

7.51 While the above operations are taking place at the test desk, a similar series of events is taking place in the far-end RTC, except that there the tone is actually connected to the tip and ring leads of the subscriber line and there is no lamp involved. The actions there are not precisely synchronized with the test desk, but will be close enough for practical purposes.

7.52 The above status is maintained until the timer times out, or the subset goes on-hook. When the timer times out, it grounds the EC lead. This operates relay H1. Relay H1 operated:

- (a) Closes, in part, a path to light lamp H steadily.

- (b) Locks under control of the H key.
- (c) Opens the holding path of relay H, causing it to release.

7.53 Relay H released:

- (a) Removes ground from the interrupter ST lead.
- (b) Removes ground from the timer ST lead.
- (c) Completes a ground path to light lamp H steadily.

7.54 At the distant office the far-end RTC is performing in a similar manner except that it removes the tone from the subscriber line and there is no lamp.

7.55 Release of the H key releases relay H1 and extinguishes lamp H. It also removes ground from the H lead to the near-end RTC. The Remote Testing Circuits then restore from the receiver off-hook tone application condition. Reoperation of the H key restarts the entire cycle.

7.56 If, during the application of receiver off-hook tone, the subset changes to on-hook, the near-end RTC will remove ground from lead HS (by the operation of relay S in that circuit). This allows relay SR1 to release.

7.57 The release of relay SR1 causes relay H1 to operate under control of key H. Relay H1 operated:

- (a) Partially closes the ground path to light lamp H steadily.
- (b) Locks under control of key H.
- (c) Releases relay H.

7.58 Relay H released:

- (a) Releases the timer and interrupter by removing ground from the ST leads.
- (b) Completes the ground path to light lamp H steadily.

7.59 At the distant office in the far-end RTC, a similar action takes place, except there is no lamp involved and tone is removed from the subscriber line.

7.60 Release of the H key will restore all involved circuits to normal at any stage of the receiver off-hook tone application.

"TOUCH-TONE" STATION TESTS

7.61 TOUCH-TONE station tests in the remote testing mode are done in the same manner as in the nonremote testing mode with only minor differences in how it is handled by this circuit. The TT key operated now

does nothing useful to the sleeve circuit, but it grounds the TT lead to the near-end RTC. This causes the near-end RTC to send the required order to the distant office where the end result will be the same as in the nonremote testing mode. See 4.61 for a more complete description of the test.

SECTION III - REFERENCE DATA1. WORKING LIMITS

Relays	Max Ext Ckt Loop	Max Ext Ckt Res	Max Earth Pot.	Min Ins Res
	ohms		volts	ohms
P, S, TN	3000		±20	10,000
RL	1900		±25	60,000
PS, SS	6000		0	60,000
PS, SS		2300	±15	60,000

2. FUNCTIONAL DESIGNATIONS2.01 Relays

<u>Designation</u>	<u>Meaning</u>
BD	Breakdown
BD1	Breakdown 1
BD2	Breakdown 2
CN	Coin
D	Dial
DA	Dial A
DB	Dial B
DC	Dial C
DD	Dial D
DE	Dial E
DL	Dial on line
DT	Dial test
DT1	Dial test 1
ELV	Electronic voltmeter
H	Howler, receiver, off-hook tone
H1	Howler 1, receiver, off-hook tone 1
M	Monitoring
NP	N primary
NS	N secondary
P	Primary
PS	Primary sleeve
REX	Range extension
RL	Release
ROHU	Receiver off-hook (Unigauge)
RT	Remote testing
RT1	Remote testing 1
RV	Reverse
S	Secondary
SL	Sleeve
SR1	Supervisory 1
SS	Secondary sleeve
SS1	Secondary sleeve 1

DesignationMeaning

STA	Station
TK	Talk
TN	Tone
TN1	Tone 1
TN2	Tone 2
UTC	Unigauge Tone Control
VB	Voltage bridge

2.02 CapacitorsDesignationMeaning

AC	Alternating current
CN	Coin
N	Alphabetical designation
P	Primary
PR	Primary ring
PT	Primary tip
RT	Relay test
RT1	Relay test 1
S	Secondary
SR	Secondary ring
ST	Secondary tip
TN	Tone
TN1	Tone 1
TR	Transmission
TR1	Transmission 1

2.03 CordsDesignationMeaning

PRI	Primary
SEC	Secondary
SO	Sounder

2.04 KeysDesignationMeaning

AC	Alternating current
ADJ	Adjust
BG	Buzzer guard
BT1	Breakdown test 1
BT2	Breakdown test 2
CC	Coin Collect
CONN RLS	Connector release
CR	Coin release
CTT	Coin trunk tip
DIAL (PRI)	Dial primary
DIAL (SEC)	Dial secondary
DO	Distant office
DSL	Dial subscriber line

<u>Designation</u>	<u>Meaning</u>
EL VM	Electronic voltmeter
FEMP	Foreign electromotive force
G (PRI)	Ground primary
G (SEC)	Ground secondary
H	Howler, receiver, off-hook tone
HSDT	High-speed dial test
IN (PRI)	In primary
IN (SEC)	In secondary
LRF	Line relay prepay
LSDT	Low speed dial test
M (PRI)	Monitor primary
M (SEC)	Monitor secondary
MDF	Main distributing frame
MET VM	Metallic voltmeter
NT	No test
PS RLS	Permanent signal release
RCCI	Repeating coil cut in
RCCO	Repeating coil cut out
REV (PRI)	Reverse primary
REV (SEC)	Reverse secondary
REX	Range extension
RHE	Rheostat
S	Sounder
SC	Short circuit
SET 10	Set 10 (pulses per second)
SET 18	Set 18 (pulses per second)
SSRT	Subscriber relay test
-STA	Negative station
+STA	Positive station
T (PRI)	Talk primary
T (SEC)	Talk secondary
TD	Test disconnect
TEST	Test
TMT	Transmission test
TT	TOUCH-TONE
TTS	Test trunk and selector
VM REV	Voltmeter reverse
X	Transpose
3WO (PRI)	Third wire open primary
3WO (SEC)	Third wire open secondary
24MA	24 milliamperes
24V	24 volts
4X4	4X4 (TOUCH-TONE calling)
60V	60 volts
100	100 volts

<u>Designation</u>	<u>Meaning</u>
200	200 ohms
400	400 ohms
800	800 ohms
1000	1000 ohms
2000	2000 ohms

2.05 Lamps

<u>Designation</u>	<u>Meaning</u>
BT	Breakdown test
DT	Dial test
H	Howler, receiver off-hook tone
P	Primary
S	Secondary

2.06 Plugs

<u>Designation</u>	<u>Meaning</u>
PRI	Primary
SEC	Secondary
SO	Sounder

3. FUNCTIONS

3.01 Control of the connection of the primary and secondary test circuits to the associated tip, ring, and sleeve conductors.

3.02 Provision of talking and monitoring connections, primary and secondary test circuits.

3.03 Establishment of connections to subscriber lines and cable conductors, through test trunks, from the primary and secondary test circuits.

3.04 Testing of subscriber lines and cable conductors with the primary test circuit feature as follows:

- (a) Provision of test battery, a volt-milliammeter, and associated scale change keys.
- (b) Determination of the conduction of subscriber lines and cable conductors by use of the meter circuit.
- (c) Investigation of high-resistance faults by means of an electronic voltmeter test circuit.
- (d) Detection of the presence of ac voltage on a line.
- (e) Operation test of subscriber line relay.
- (f) Test dialing on subscriber lines by means of the position dial.

- (g) Operation test of a coin trunk circuit connected to a subscriber line (step-by-step offices).
 - (h) Test of the transmission quality of subscriber lines.
 - (i) Operation test of subset relays.
 - (j) Operation test of subset cold cathode tubes.
 - (k) Operation tests of coin telephones.
 - (l) Breakdown test of line insulation.
- 3.05 Testing of subscriber lines and cable conductors with the secondary test features as follows:
- (a) Receiver off-hook tone application.
 - (b) Dial speed test.
 - (c) Conductor identification.
 - (d) Provision for establishing the remote testing condition.
- 3.06 Testing of subscriber lines using remote testing as follows:
- (a) Provision of a volt-milliammeter and associated scale change keys.
 - (b) Determination of the condition of subscriber lines and cable conductors by use of the meter circuit.
 - (c) Operation test of subscriber line relay.
 - (d) Operation test of subset relays.
 - (e) Operation test of subset cold cathode tubes.
 - (f) Operation tests of coin telephones.
 - (g) Receiver off-hook tone application.
- 3.07 Provision for selection of test trunks in distant office when remote testing is used.
- 3.08 Provision of a control means for the TOUCH-TONE frequency test applique circuit, or equivalent in ESS offices. This permits making TOUCH-TONE station calling tests under control of the local test desk.
- 3.09 Provision of means to send TOUCH-TONE calling signals in place of mechanical dial pulses under certain conditions.
- 3.10 Provides loop closure on start leads to turn on signal generator when signaling per 3.09 is required.

4. CONNECTING CIRCUITS

- 4.01 When this circuit is listed on a key-sheet the information thereon is to be followed.
- (a) Telephone Circuit - SD-95754-01.
 - (b) Primary Ringing Circuit - SD-90498-01.
 - (c) Secondary Ringing Circuit - SD-95741-01.
 - (d) MF Keyset Circuit - SD-95570-01.
 - (e) Electronic VM Test Circuit - SD-95596-01.
 - (f) Tone Supply Circuit - SD-95689-01.
 - (g) Line Insulation Breakdown Test Circuit - SD-94772-01.
 - (h) Howler Circuit - SD-95773-01.
 - (i) Dial Test Circuit - SD-96335-01.
 - (j) Flashing Circuit - SD-95725-01.
 - (k) Circuits Requiring TST BAT Supply.
 - (1) Miscellaneous Circuits for Final Selector Frame - SD-21231-01 (typical).
 - (2) O.G.T. Test Frame - SD-21577-01 (typical).
 - (3) Trouble Position - ES-10636-01 (typical).
 - (4) Sender Make Busy Frame - SD-21697-01 (typical).
 - (5) Local Test Cabinet - SD-96205-01.
 - (l) Wheatstone Bridge Test Circuit - SD-95769-01
 - (m) Miscellaneous Circuits for Miscellaneous Interrupter Frame - SD-21666-01 or SD-21667-01.
 - (n) Miscellaneous Interrupter Circuit - SD-25062-01.
 - (o) Test Trunk Circuit - SD-95737-01.
 - (p) Remote Testing Circuit - Near End - SD-99310-01.
 - (q) Near End Test Trunk or Line Circuit - SD-99309-01.
 - (r) Remote Testing Circuit - Far End - SD-99311-01.
 - (s) Timer Circuit - SD-99304-01.
 - (t) Tone Generator Circuit - SD-99303-01.
 - (u) Far End Test Trunk or Line Circuit - SD-99308-01.

- (v) +48-Volt Power Supply Circuit - SD-81571-01.
- (w) Voice-Operated Switched Gain Repeater Circuit - SD-99488-01.
- (x) Signal Generator Circuit - SD-99328-01.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

- A.1 Provides for testing of coin telephones with dial tone first feature.

B. Changes in Apparatus

B.1 Added

CR23, 446F diode - ZS option - App Fig. 1
 CR24, 446F diode - ZS option - App Fig. 1
 TF - 18EY resistor - ZP option - FS 5
 B1, B2 - KS-15998 Battery - App Fig. 2

B.2 Superseded Superseded By

AlABP key, Fig. 1, AlACF key, Fig. 1,
 option ZF option ZT

D. Description of Changes

- D.1 The following are made to permit testing of dial tone first coin telephones.
- D.2 In FS 5 the lead from 1B to 3T of the CN relay is designated option Z0 (A&M Only). A new lead from 1B of CN relay to new resistor GR has been added. Both are ZP option. From resistor GR a lead has been added to FS 9. These changes are to permit grounding the ring lead through a resistor when testing dial tone first coin telephones.
- D.3 In FS 9 the G lead to remote testing near end direct from 3D of G(PR1) key is designated ZR (A&M Only). ZQ (A&M Only) and ZS (STD) options and diodes CR23 and 24 are added to ground the ring lead through a resistor when testing dial tone first coin telephones.
- D.4 The G key per option ZH is also coded option ZP.
- D.5 Circuit Notes 112 and 113 are added for options ZP, ZQ, and ZS.
- D.6 Options Z0, ZP, ZQ, ZR, ZS, and ZT are added to the Option Used table.
- D.7 In FS 10, the 4X4 key, option ZF, has been replaced by 4X4 key option ZT. This allows new contacts 4,5B to be used to close loop start leads ST and ST1 to the MF Keyset Circuit.
- D.8 In App Fig. 1 new key AlACF, option ZT, is added.
- D.9 Lead index for MF Keyset Circuit has leads ST and ST1 added.
- D.10 Apparatus index has added diodes CR23 and CR24 and resistor GR.
- D.11 Circuit Note 114 has been added.
- D.12 In circuit note 101 the voltage range for CC+ C has been added.
- D.13 Circuit Note 104 has been updated for this issue.
- D.14 Circuit Note 108 has been modified for added clarity.
- D.15 In FS 10, wiring of contacts 4,5C of REX key has been changed to agree with wiring drawings.
- D.16 In FS 11, wiring of contacts 2,3C of REX key has been changed to agree with wiring drawings, and the ZI, ZJ options for wiring to resistor PR have been interchanged to correct an inadvertant error.
- D.17 In FS 5 reference to note 304 has been added for leads to coin control supply.
- D.18 In FS 14 a ZJ option lead from 1C of H key has been added to correct an omission.
- D.19 In FS 14 multipling has been clarified for leads to interrupter supplies.
- D.20 In FS 2 pairing has been added for leads T3,R3 and T4,R4 to FS 1.
- D.21 In FS 17 the battery symbol for B1 is now poled correctly.
- D.22 In App Fig. 1 the keytop for 4X4 etc., keys is updated.
- D.23 CAD 2, 12, and 13 have been changed to reflect above changes.
- D.24 CAD 10 at terminals 10, 11 has ZB option deleted and pairing added on cable side.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5822-KES-WAM

